NASA/CP—1999-209318

HBCUs/OMUs Research Conference Agenda and Abstracts

August 1999

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HBCUs/OMUs Research Conference Agenda and Abstracts

Proceedings of a conference held at and sponsored by
Ohio Aerospace Institute
Cleveland, Ohio
April 14–15, 1999

National Aeronautics and
Space Administration

Glenn Research Center

August 1999

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GRC HBCUs/OMUs RESEARCH CONFERENCE

APRIL 14–15, 1999

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National Aeronautics and
Space Administration

John H. Glenn Research Center
Lewis Field
Cleveland, OH 44135-3191

Reply to Attn of:

The NASA John H. Glenn Research Center's (GRC) commitment to excellence continues to grow in terms of investment and support for Historically Black Colleges and Universities (HBCU's)/Other Minority Universities (OMU's). Our total research and development grant awards to HBCU's/OMU's continue to exceed our performance goal by a substantial margin.

GRC's HBCU's/OMU's Research Program is designed to utilize the capabilities of HBCU's/OMU's to conduct fundamental science and develop physical infrastructure related to NASA's disciplines. To reach our goals, we build partnerships with other Government agencies, industry, and academia. Our research partnerships with the Nation's HBCU's/OMU's are an integral part of our strategy.

The HBCU's/OMU's Research Conference is a critical element in ensuring the success of GRC's research programs. In addition, it provides a forum for showcasing the research capabilities of the participating HBCU's/OMU's.

It is with great pleasure that I welcome the participants and congratulate everyone associated with the NASA HBCU's/OMU's Research Conference.

Donald J. Campbell
Director

National Aeronautics and
Space Administration
John H. Glenn Research Center
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Cleveland, OH 44135-3191

Reply to Attn of:

I extend my welcome to all attendees at this Historically Black Colleges and Universities (HBCU's)/Other Minority Universities (OMU's) Research Conference. This Conference provides the opportunity to showcase the high quality of the John H. Glenn Research Center (GRC)-sponsored research conducted at the Nation's HBCU's/ OMU's. I congratulate the Principal Investigators, Student Researchers, and GRC Technical Monitors for your competence and contributions.

I invite all attendees to actively participate with your questions, comments, and suggestions concerning all aspects of the Conference. Your feedback and support are critical to the success of these Conferences.

Julian M. Earls
Deputy Director for Operations

HBCU's/OMU's RESEARCH CONFERENCE
April 14–15, 1999

AGENDA

Presiding: Dr. Sunil Dutta
SDB Program Manager

Wednesday, April 14, 1999

8:00 – 8:30 a.m.	Registration
8:30 – 9:00 a.m.	Introduction and Welcome
	Dr. Julian M. Earls Deputy Director for Operations NASA Glenn Research Center
	Dr. Michael J. Salkind President Ohio Aerospace Institute
	Mr. Donald J. Campbell Director NASA Glenn Research Center
9:00 – 10:20 a.m	Oral Presentations
10:20 – 10:40 a.m.	Break
10:40 – 12:00 Noon	Oral Presentations
12:00 – 1:30 p.m.	Lunch (On Your Own)
1:30 – 2:40 p.m.	Oral Presentations
2:40 – 3:00 p.m	Break
3:00 – 4:10 p.m.	Oral Presentations

Thursday, April 15, 1999

8:30 a.m. – 12:30 p.m.	**NASA HEADQUARTERS SMALL DISADVANTAGED BUSINESS (SDB) FORUM** (Continuation of HBCU's Research Conference)
8:30 – 9:00 a.m.	Introduction and Welcome
	Dr. Julian M. Earls Deputy Director for Operations NASA Glenn Research Center

	Dr. Michael J. Salkind President Ohio Aerospace Institute
	Mr. Donald J. Campbell Director NASA Glenn Research Center
	General Spence M. Armstrong Associate Administrator for Aero-Space Technology NASA Headquarters
9:00 – 12:30 Noon	Awards Ceremony Presentations by SDB's and HBCU's
12:30 – 1:30 p.m	Lunch (On Your Own)
1:30 – 3:00 p.m	Poster Sessions
3:00 – 4:00 p.m.	Individual Principal Investigator/Technical Monitor Meeting
4:00 – 5:00 p.m	Remove Posters

HBCU's/OMU's Research Conference
List of Poster Papers
April 14-15, 1999

P1	Clark Atlanta University	"Long Term Durability of Polymer Matrix Composites for High Temperature Applications"
P2	Fisk University	"Consortium for Advancing Renewable Energy Technology"
P3	Florida A&M University and The Florida State University	"Plasma-Enhanced Pulsed Laser Deposition of Boron Nitride Thin Films for Alphavoltaic Device Applications"
P4	Grambling State University	"Polymerizable Monomer Reactants—Modified Polyimides"
P5	Hampton University	"Parallelization of Rocket Engine System Software (PRESS)"
P6	Howard University	"A Neuro-Fuzzy Approach for Load Forecasting and Fuel Minimization for the Hybrid Electric Vehicle"
P7	Howard University	"Aerospace Power System Load Shedding With Reliability Constraint"
P8	Howard University	"Experimental Evaluation of Motor Drive Technologies for Future Aerospace Applications"
P9	Howard University	"Experimental Implementation of High Performance AC Drives Using Neural Designs"
P10	Jackson State University	"A Software Architecture for Intelligent Interface to a Rocket Engine Numerical Simulation Package"
P11	Louisiana State University	"Microstructure and Numerical Analysis of Hot Forging of Duplex Titanium Aluminide"
P12	New Mexico University	"Development of a High-Order Time-Accurate Simulator for Complex Combustion Models"
P13	New York City College	"High Resolution Experiments of Compressible Turbulence Interacting With Shock Waves"
P14	New York City College	"Surfactant Facilitated Spreading of Aqueous Drops on Hydrophobic Surfaces"
P15	New York City University	"NASA Early Learning Communities Project"
P16	New York City University College	"Optical Imaging of Flow Pattern and Phantom"
P17	North Carolina A&T State University	"Aerothermo-Structural Analysis of Low Cost Composite Nozzle/Inlet Components"
P18	Prairie View A&M University	"Radiation Effects on DC-DC Converters"
P19	Savannah State University	"ACTS Ka-band Propagation Research in a Spatially Diversified Network With Two USAT Ground Stations"

P20	Savannah State University	"Acceptance Testing of a Satellite SCADA Photovoltaic-Diesel Hybrid System"
P21	Savannah State University	"PV-Diesel Hybrid SCADA Experiment Network Design"
P22	Tennessee State University	"Three-Dimensional Numerical Simulation of Convective Melting of Solid Particles in a Fluid"
P23	Tennessee State University	"The Design of Particle Melting in Flow Flight Module (PMF) for Microgravity Tests"
P24	Tennessee State University	"Tennessee State University (TSU) Research Project for Increasing the Pool of Minority Engineers"
P25	Texas University of San Antonio	"Research and Education in Probabilistic Structural Analysis and Reliability"
P26	Tuskegee University	"Copper-Based OHMIC Contacts for the Si/SiGe Heterojunction Bipolar Transistor Structure"
P27	Tuskegee University	"Sputtering Erosion in the Ion Thruster"
P28	Tuskegee University	"Characterization of Flow Behind the Fan of a Turbofan Engine"
P29	University of West Florida	"Institutional Memory Preservation at NASA Glenn Research Center"
P30	Wilberforce University	"Wilberforce Power Technology in Education Program "

GRC HBCUs/OMUs RESEARCH CONFERENCE

Long Term Durability of Polymer Matrix Composites for High Temperature Applications

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ABSTRACT

The objective of this research is to identify the mechanisms of damage in tension-tension, fatigue of unidirectional T650-35 carbon fiber/AMB-21 polyimide laminates. AMB-21 is a polymer developed by NASA GRC as a noncarcinogenic environmentally friendly polyimide. An experimental study was conducted to investigate the mechanical behavior of the unidirectional T650-35/AMB-21 polymer composite system and the AMB-21 resin matrix. Quasi-static tensile and fatigue properties were examined. Accomplishments included successful fatigue testing with tabbed dog-bone shaped specimen in which failure occurred away from the tabs. The data obtained will help in assessing replacement of PMR-15 with AMB-21 as a matrix for high temperature applications. Fatigue experiments at room temperature and high temperature (230 C) have been conducted for several unidirectional dog bone samples at a level of maximum stress, S_{max} = (0.70 – 0 90) σ_{ult}, with R_σ = 0.1 ($\sigma_{min}/\sigma_{max}$). The S_{max} values were based on the average ultimate tensile strength, σ_{ult}, obtained from the static tensile test ($234x10^3$ psi at room temperature and $195x10^3$ psi at 230 °C). A cyclic load frequency of 10 Hz with a sinusoidal command waveform was employed. All high temperature tests were conducted under isothermal conditions. A test fixture made of aluminum machined into two matching halves was used Each half of the fixture contained resistance heater rods. Heat from the fixture was transferred to the test specimen through direct contact of fixture and specimen along the entire length of the fixture and across the entire width of the specimen. The fatigue life diagram for tension-tension loading of the unidirectional T650-35/AMB21 laminates was determined. The axes of the diagram are strain arid logarithm of the load cycles to failure. Although fatigue testing is done under controlled load, the variable on the vertical axis of the diagram is the maximum strain attained in the first load cycle. The significance of the maximum strain is that this quantity represents the state of damage reached in the first load cycle and it is reasonable to expect that any progression of damage in subsequent load cycles will be determined by this state of damage. Furthermore the two extreme states in fatigue, i.e., the static failure and the fatigue limit, are given generically in terms of strain.

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Consortium for Advancing Renewable Energy Technology

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ABSTRACT

The Consortium For Advancing Renewable Energy Technology (CARET) program is a research and education program involving four universities and NASA's John H. Glenn Research Center at Lewis Field. These four universities (Fisk, Wilberforce, Central State and Kent State Universities) are working together with NASA Glenn to use the theme of renewable energy to improve science education and research for minority students. CARET is pursuing this improvement by involving some students and postdoctoral mentors in research on materials, quantum dot phenomena and radiation effects. Other students are involved in more applied activities such as participating in the design and installation of renewable energy power and water pumping demonstration systems. Still others focus more on educational activities such as preparing and presenting PowerPoint presentations on renewable energy to secondary school students. The consortium is also developing a pipeline mechanism which actively works with students interested in these areas to manage their educational opportunities within the consortium and working with students to develop educational programs for secondary school students. This has resulted in students from member HBCUs attending summer internship programs at other member institutions and a graduate of Wilberforce enrolling in graduate school at Kent State University. And finally, CARET is addressing this objective by expanding the educational opportunities available to consortium students. This is being done by establishing a distance learning link between Wilberforce and Kent State Universities whereby presentations and resources of the School of Technology at Kent State are made available to Wilberforce and Central State students. This presentation will focus on the student involvement and achievements in the educational area, while a presentation of some of the research results will be provided in the accompanying poster.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Plasma-Enhanced Pulsed Laser Deposition of Boron Nitride Thin Films for Alphavoltaic Device Applications

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ABSTRACT

The concept of generating low-level currents in the micro- to milliamp range using high-energy particles in conjunction with a photovoltaic device was successfully demonstrated over two decades ago using silicon-based solar cell technology. Unfortunately, device lifetime was severely limited due to the cumulative effects of radiation-induced damage. We have proposed using cubic boron nitride and related ultrawide bandgap semiconductor materials as the basis for an "alphavoltaic" device, since the bandgap energy of the semiconductor is irrelevant in radioisotope applications where the incident energy averages several hundred keV to several MeV. Our approach is the development of an enhanced pulsed laser deposition technique, where active nitrogen is supplied using an inductively coupled RF plasma source identical to that used to grow high quality GaN LEDs by molecular beam epitaxy. The boron or aluminum is supplied by ablating a suitable target with a KrF excimer laser at energy densities in the range of 0.3 to 3 J/cm^2. Lattice-matched polycrystalline diamond substrates are used as opposed to silicon, which although most commonly used, presents a considerable lattice mismatch. Results of in-situ reflection high-energy electron diffraction (RHEED), and post-growth analysis using scanning electron microscopy (SEM), atomic force microscopy (AFM), x-ray diffraction, x-ray photoelectron spectroscopy (XPS), Raman spectroscopy and Fourier transform infrared spectroscopy (FTIR) will be presented.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Polymerizable Monomer Reactants—Modified Polyimides

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ABSTRACT

Our research investigation focuses on the preparation of polyimides. Reaction of dianhydrides (e.g., 3,3', 4,4'-benzophenonetetracarboxylic dianhydride), with a diamine based monomer, produces a polymer which is expected to be of potential use in high temperature (polymer) applications. The monomers of interest in this study are proposed to exhibit significant advantages in the area of flowered energy requirements during the mold process of these polymers. The resulting modified polyimides are being studied using Differential Scanning Calorimetry (DSC) and Thermal Gravimetric Analysis (TGA). Once thermal characterization has been completed on the modified polyimides our investigation extends to aging and rheological profiles, including dynamic mechanical analysis. At this point in our study we present the results of the thermal data and aging studies of the materials.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Parallelization of Rocket Engine System Software (PRESS)

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ABSTRACT

The principal aim is to assess parallelization requirements for Fortran based software packages developed as part of Rocket Engine Numeric Simulator (RENS) project. During the first-year, Two-Dimensional Kinetics (TDK), a very large package was studied. During the second-year, we analyzed turbine and pump design packages TURBDES/PUMPDES. During the third year, we have worked on integrating the GASP subsystems into the TURBDES/ PUMPDES using the driver code RESSAP (Rocket Engine System Sizing end Analysis Program). In our final report, dated October 18, 1999, we showed how RESSAP code can run over a local network using Message Passing Interface (MPI) facilities. As discussed in previous progress reports, after experimenting with distributed computations over UNIX based local networks using standard public-domain tools MPI or PVM (Parallel Virtual Machine), the next step is distributed computing over heterogenous, UNIX or NT based, intranets and over the Internet. For this purpose, an evolving set of standards called COmmon Object Request Broker Architecture (CORBA) is the most appropriate tool. While supporting object-oriented languages and applications through standard Interface Definition Language (IDL), there is a possibility of support for Fortran based applications through C++ wrappers. Otherwise, through process reengineering, various rocket engine design software tools can be converted to an object-oriented format thereby allowing the use of CORBA facilities. At present, the two popular vendor offerings based on CORBA standards are Iona's OrbixWeb and Visigenic's VisiBroker. Since VisiBroker have been chosen for Netscape browser support and incorporates Java, it is a useful tool for the internet, as well. Indeed, VisiBroker is sometimes also referred to as CORBA+JAVA. Recently there has been a rapid progress in the evolution of CORBA in supporting distributed computing. Some of these developments have been discussed in our final report for the PRESS project which is currently on its one-year no-cost extension period. The accompanying 15-minute presentation will through some light into such developments. Meanwhile, we are currently in the process of acquiring an integration and optimization tool from Enginous Software, Inc. This package is called I-Sight and is a promising one for integrating RENS Fortran based code for more efficient use and sharing. If, by the time of the presentation, we are able to purchase and install I-Signt on our NT server, we will provide a description of its capabilities and promise for RENS software as part of the presentation.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

A Neuro-Fuzzy Approach for Load Forecasting and Fuel Minimization for the Hybrid Electric Vehicle

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ABSTRACT

The paper presents an Artificial Neural Network, ANN, based-load forecasting and Fuzzy Logic, FL, based-fuel minimization for the energy control of the Hybrid Electric Vehicle, HEV. A detailed design of the forecaster and fuzzy logic module including data collection scheme, training, developing of the fuzzy rules, testing and implementation is presented. The data needed for the training and testing processes is obtained using simulation results from analysis of the HEV simulation model program, HEVA, developed by NASA Glenn Research Center. The ANN based-Load Forecaster is trained using the Error Back Propagation, EBP, algorithm, which is implemented using a robust back propagation program. Also, Matlab-based fuzzy rules for fuel minimization are developed. The scheme is integrated around HEVA program and tested for different operating conditions. The proposed scheme is capable of guiding the HEV operator to the optimal operating performance parameters.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Aerospace Power System Load Shedding With Reliability Constraint

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ABSTRACT

Aerospace power system automation requires adequate power to meet critical load functions during known and uncertain system conditions. The uncertainties in load, network change cause system disturbance which could lead to changes in system congestion margin and reliability. The curtailment of load should adequately include value, location and cost while at the same time include reliability and congestion margin. Under this project Howard University research team and the NASA mentor have designed a scheme which uses an Everett optimization method for load shedding without solving optimization with "stationary point." The load shed and generation control are determined by using reliability index LOLP, EUE to validate system control before a control option is done. The integrated scheme consists of five modules:

(1) The expected congestion margin during high power demand or during minimum generation schedule or system violations.
(2) Reliability of system or component needed prior in determining the load shedding scheme, and determination of risk assessment during system operation.
(3) Determination of options needed for mitigating System Vulnerability, these options include generation rescheduling, running system at a risk and load curtailment.
(4) Determination of strategy for load curtailment for coordinating system conditions and available control.
(5) Cost Benefit analysis.

The scheme is tested using a benchmark NASA system consisting of generators, loads and network. The scheduled loads are prioritized and the corresponding reliability indices are provided. The scheme will assist power management on board the space station.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Experimental Evaluation of Motor Drive Technologies for Future Aerospace Applications

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ABSTRACT

This study presents the design and experiment of a hybrid fuzzy control scheme for a high performance brushless dc drive system. Both the designs of the fuzzy controller and its integration with the proportional-integral (PI) in a global control scheme are discussed. The principle of the proposed control scheme is that to use a PI controller, which performs satisfactory in most cases, while keeping in the background à fuzzy controller, which, is ready to take over the PI controller when severe perturbations occur. Performance of the hybrid fuzzy-PI controller is evaluated through a laboratory implementation. The laboratory implementation is based on a linguistic fuzzy controller whose design is derived from the expert knowledge during disturbed phases. Experimental results have shown excellent tracking performance of the hybrid control system, and have convincingly demonstrated the usefulness of the hybrid fuzzy controller in high performance drives with uncertainties. The proposed controller is designed and implemented in the laboratory and its effectiveness in tracking application is verified. The entire system is built and tested in the laboratory by using off-the-shelf components and software. The research study also discusses both the designs of the fuzzy controller and its integration with the PI in global control system. Results from online implementation are presented.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Experimental Implementation of High Performance AC Drives Using Neural Designs

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ABSTRACT

This study presents an adaptive nonlinear-model-based observer, using an artificial neural network (ANN) which is trained while the observer is operating on-line. The adaptation mechanism uses continual on-line training (with no off-line training) to learn the unknown nonlinear dynamics and estimate the unmeasurable states of an induction machine. The proposed architecture incorporates five-multilayer percepton ANNs that are on-line trained, using the Levenburg-Marquadt learning algorithm. The objective is to track the time-varying stator currents of the induction motor using only input/output observations. This is done by using the neural observer to emulate the motor dynamics and generate estimates of the unmeasurable states. Subsequently, the estimated states are fed into the neural controller to track the stator current trajectories. The actual controller is not constructed as the output of an independent system, but rather as a feedback signal, depending on the state variables of the motor supplied by the neural observer and the reference trajectories to be tracked by the outputs. An adaptive learning mechanism, which attempts to keep the learning, rate as large as possible, while maintaining the stability of the learning process, is proposed. This mechanism simplifies the learning algorithm in terms of computation time, which is important in real-time implementation. The control of the direct and quadrature components of the stator current successfully tracked a wide variety of trajectories after relatively short, on-line training periods.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

A Software Architecture for Intelligent Interface to a Rocket Engine Numerical Simulation Package

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ABSTRACT

A rocket engine simulation system, like many other numerical packages, is primarily a library of routines. Each of these routines simulates the behavior of a component and/or a physical process. Using a package-specific scripting language the user develops a model, which primarily seeks to assemble some of those routines. A preprocessing program belonging to the package reads the user's script code and develops an executable program to be run on some input values provided by the user, possibly in another file. In our current project (ESA-RENS) we have developed software architecture of an intelligent interface to the package in order to relieve the burden of the user from knowing some details about the package itself. This would reduce the training cost, as well as improve the model development and debugging time to a great extent. It will also help the software developer's attempt in introducing new routines to the package. In this paper we present the architecture and its significance in the process of simulation. We will also discuss some problems related to our goal, and indicate the future direction that the research is likely to take.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Microstructure and Numerical Analysis of Hot Forging of Duplex Titanium Aluminide

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ABSTRACT

Gamma titanium aluminide is an attractive material for high temperature engine components in the aerospace, aeronautical, and automobile industries. Hot forging process is one of the major manufacturing processes for production of turbine blades and other engine components. Integration of microstructure characteristics in the hot forging process has been investigated by different researchers. This paper is going to report our investigation on the mathematical integration of microstructure characteristics and evolution in the flow stress relationship during hot forging of titanium aluminide. Sandstrom and Lagneborg model and numerical analysis approach by Pietrzyk were used in this analysis. Titanium aluminide with a composition of 46-50 at%. Al and a duplex microstructure was used for verification of the model. Compression tests were conducted in the temperature range between 950-1100 °C and strain rates of 0.001 0.1 s^{-1}. Metallographical examination indicated microstructural changes in the original duplex morphology due to dynamic recovery, recrystallization, and grain growth. Experimental stress-strain relationships for different conditions used for verification of the simulated curves.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Development of a High-Order Time-Accurate Simulator for Complex Combustion Models

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ABSTRACT

We discuss our work on the design, implementation, and testing of high-order numerical methods for solving complex physical models of time-dependent, low Mach number, combustion phenomena. Features of the code include:

(a). Fourth to sixth order, explicit and implicit, elliptic spatial differencing;
(b). Linearly implicit time-stepping using simplified diffusion models as preconditioners. High order accuracy is achieved using spectral deferred correction;
(c). Capability to directly compute steady flames using convergence acceleration techniques;
(d). Adaptive mesh refinement based on coordinate maps.

Numerical examples in one space dimension will be given, along with a discussion of issues related to multidimensional implementations.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

High Resolution Experiments of Compressible Turbulence Interacting With Shock Waves

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ABSTRACT

The interaction of turbulent jet with a traveling shock wave has been investigated experimentally in a high resolution large scale shock tube facility. A jet facility has been designed and tested which can supply a flow with a Mach number of 0.9 through a 7.0 mm internal diameter tube exhausting along the center line of the shock tube. Two test flow configurations have been used in these experiments. In the first one, the jet was flowing in the same direction as the traveling shock wave. In the second configuration, the shock was traveling in the opposite direction to that of the shock. Helium, air and Krypton gases were used in the jet flows in an effort to generate baroclinic vorticity through a nonalignment of density and pressure gradients. Extensive flow visualization studies were carried out by using a pulsed planar laser sheet generated by a Nd:YAG lower. The captured images show that the interaction is very complex. A stenosis of the jet has been observed to take place in the near field as a result of the sudden imposition of the pressure behind the shock which is followed by a "wake like" vortex. The field far from the jet exit is characterized by increased turbulence activities. Substantial more mixing has been observed in the case of a Helium jet than in the case of a Krypton jet, as a result of the difference in the generation of additional baroclinic vorticity.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Surfactant Facilitated Spreading of Aqueous Drops on Hydrophobic Surfaces

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ABSTRACT

An aqueous phase does not wet a hydrophobic surface. When an aqueous drop is placed on such a surface, the liquid subtends a large contact angle with the solid. The capillary force derived from the large angle either prevents the drop from moving, or causes it to move very slowly before coming to rest. In either case, the wetted area at equilibrium is minimal. Existing or potential microgravity technologies such as contact film cooling, mold filling and coating processes often require aqueous phases to spread in a rapid and complete manner over solid surfaces. These surfaces are usually hydrophilic so that they are readily wet by water. However, in the normal course of operation, contaminant hydrophobic can be deposited patchwise on the surface. Surfactants facilitate the wetting of water on hydrophobic surfaces by adsorbing on the water/air and hydrophobic solid/water interfaces and lowering the surface tensions of these interfaces. The tension reductions decrease the contact angle, which increases the rate of spreading and the equilibrium wetted area. Hydrocarbon surfactants (i.e. amphiphiles with a hydrophobic moiety consisting of an extended string of methylene-CH_2-groups attached to a polar group) are capable of reducing the contact angles on surfaces which are not very hydrophobic, but do not reduce significantly the contact angles of the very hydrophobic surfaces such as parafilm polyethylene or self assembled monolayers. Trisiloxane surfactants (amphiphiles with a compact hydrophobe consisting of methyl groups linked to a trisiloxane backbone ($(CH_3)_3Si\text{-}O\text{-}Si\text{-}O\text{-}Si(CH_3)_3$) and an extended ethoxylate ($-(OCH_2CH_2)_n-$) polar group with seven or eight units can significantly reduce the contact angle of water on a very hydrophobic surface and cause rapid and complete (or nearly complete) spreading. The overall goal of the research described in this proposal is to develop and verify a theory for how trisiloxanes cause superspreading, and then use this knowledge as a guide to developing more general hydrocarbon based surfactant systems which superspread. In this presentation, we will present the results of our infrared spectroscopy study on the adsorption of surfactants at a model hydrophobic surface fabricated by the self assembly of octadecyl trichlorosilane (OTS) at the oxidized silicon surface. Fourier Transform Infrared spectroscopy in attenuated total reflection mode (FTIR/ATR) allows us to follow the structure of water at the hydrophobic solid/water interface by monitoring the molecular vibration assigned to the O-H stretching modes. As the hydrogen bonding structure of the water at the interface changes, the band shape and intensity changes. We contrast the adsorption of a superspreading trisiloxane and a polyethoxylated surfactant which does not superspread. We find a significant decrease in the intensity of the O-H stretching band in the case of the trisiloxane as it adsorbs indicating a restructuring of interfacial water, while no such change is observed for the ethoxylate. The restructuring of the water may indicate that the hydrophobic groups of the trisiloxanes are forming a hydrophobic domain adjacent to the OTS layer. As this rearrangement removes the hydrophobic groups from water, it is of low energy and may account for the significant reduction in the solid/liquid tension which underlies superspreading. In the case of the ethoxylate, the absence of water restructuring may indicate that their hydrophobic group is not as effective as that of trisiloxane in excluding water and forming this hydrophobic region adjacent to the interface.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

NASA Early Learning Communities Project

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ABSTRACT

The Hostos Early Learning Communities Project at Hostos Community College is located in one of the poorest congressional districts in the nation. The project serves twenty-five parents, thirty-five children and ten teaching staff members. This project has impacted the lives of children, parents and staff in the South Bronx by providing them with first time access to hands-on experience in technology. For the first time, young children, parents and teachers are exposed to computers and multimedia technology in a an educational setting. These children come from low-income families who do not have the financial resources to obtain personal computers. This exposure to technology has empowered parents and staff to encourage their children to pursue the educational opportunities of the present and future in the areas of math, science and technology. Through the use of age appropriate math and science software, young children are encouraged to pursue their curiosity and further develop their problem—solving and independent thinking skills. The Hostos Early Learning Communities Project has created a new set of standards and expectations for this South Bronx community by exposing them to the power of technology and it is impact on the world.

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Optical Imaging of Flow Pattern and Phantom

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ABSTRACT

Time-resolved optical imaging technique has been used to image the spatial distribution of small droplets and jet sprays in a highly scattering environment. The snake and ballistic components of the transmitted pulse are less scattered, and contain direct information about the sample to facilitate image formation as opposed to the diffusive components which are due to multiple collisions as a light pulse propagates through a scattering medium. In a time-gated imaging scheme, these early-arriving, image-bearing components of the incident pulse are selected by opening a gate for an ultrashort period of time and a shadowgram image is detected. Using a single shot cooled CCD camera system, the formation of water droplets is monitored as a function of time. Picosecond time-gated image of drop in scattering cells, spray droplets as a function of jet speed and gas pressure, and model calcification samples consisted of calcium carbonate particles of irregular shapes ranging in size from 0.1 to 1.5 mm affixed to a microscope slide have been measured. Formation produced by an impinging jet will be further monitored using a CCD with 1 kHz framing illuminated with pulsed light. The desired image resolution of the fuel droplets is on the 20 μm scale using early light through a highly scattering medium. A 10^{-6} m displacement from a jet spray with a flow speed of 100 m/sec introduced by the ns grating pulse used in the imaging is negligible. Early ballistic/snake light imaging offers nondestructive and noninvasive method to observe the spatial distribution of hidden objects inside a highly scattering environment for space, biomedical, and materials applications. In this paper, the techniques we will present are time-resolved K-F transillumination imaging and time-gated scattered light imaging. With a large dynamic range and high resolution, time-gated early light imaging has the potential for improving rocket/aircraft design by determining jets shape and particle sizes. Refinements to these techniques may enable drop size measurements in the highly scattering, optically dense region of multi-element rocket injectors. These types of measurements should greatly enhance the design of stable, and higher performing rocket engines.

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Aerothermo-Structural Analysis of Low Cost Composite Nozzle/Inlet Components

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ABSTRACT

This research is a cooperative effort among the Turbomachinery and Propulsion Division of NASA Glenn, CCMR of NC A&T State University, and the Tuskegee University. The NC A&T is the lead center and Tuskegee University is the participating institution. Objectives of the research were to develop an integrated aerodynamic, thermal and structural analysis code for design of aircraft engine components, such as, nozzles and inlets made of textile composites; conduct design studies on typical inlets for hypersonic transportation vehicles and setup standards test examples and finally manufacture a scaled down composite inlet. These objectives are accomplished through the following seven tasks: (1) identify the relevant public domain codes for all three types of analysis; (2) evaluate the codes for the accuracy of results and computational efficiency; (3) develop aero-thermal and thermal structural mapping algorithms; (4) integrate all the codes into one single code; (5) write a graphical user interface to improve the user friendliness of the code; (6) conduct test studies for rocket based combined-cycle engine inlet; and finally (7) fabricate a demonstration inlet model using textile preform composites. Tasks one, two and six are being pursued. Selected and evaluated NPARC for flow field analysis, CSTEM for in-depth thermal analysis of inlets and nozzles and FRAC3D for stress analysis. These codes have been independently verified for accuracy and performance. In addition, graphical user interface based on micromechanics analysis for laminated as well as textile composites was developed. Demonstration of this code will be made at the conference. A rocket based combined cycle engine was selected for test studies. Flow field analysis of various inlet geometries were studied. Integration of codes is being continued. The codes developed are being applied to a candidate example of trailblazer engine proposed for space transportation. A successful development of the code will provide a simpler, faster and user-friendly tool for conducting design studies of aircraft and spacecraft engines, applicable in high speed civil transport and space missions.

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Radiation Effects on DC-DC Converters

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ABSTRACT

Dc-dc converters are increasing being used in space vehicles. The natural space environment contains high-energy photons, protons and electrons that cause total-dose ionizing radiation damage. In addition, the space environment has high-energy protons and heavy ions that can introduce transient, high density charged ions through electron devices. The charged ions can interact with sensitive regions of devices to trigger catastrophic failure mechanisms. This work investigates the effects of high energy particles on dc-dc converters found in spacecraft and communication satellites. The paper reports the results of radiation studies on several dc-dc converters, undertaken to ascertain the susceptibility of total ionizing dose and single event effects. Results-to-date indicate that, of the converters simulated with total ionizing dose radiation, the performance of the Buck-Boost converter significantly degraded under radiation environment. The effects of total ionizing dose on Buck, Boost, Cuk and Flyback converters were not significant. Simulation results of the full bridge-zero voltage switching converter, under worst case single-event burnout, and single-event gate rupture conditions, show a decreasing output voltage of the converter, as increasing number of power mosfets becomes short-circuited. Under special operating conditions, the converter output voltage reduces to zero. The ongoing research work will experimentally verify the analytical results. Future efforts will be directed towards the development of converters which will reliably operate in radiation environment.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

ACTS Ka-band Propagation Research in a Spatially Diversified Network With Two USAT Ground Stations

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ABSTRACT

Congestion in the radio spectrum below 18 GHz is stimulating greater interest in the Ka (20/30 GHz) frequency band. Transmission at these shorter wavelengths is greatly influenced by rain resulting in signal attenuation and decreased link availability. The size and projected cost of Ultra Small Aperture Terminals (USATs) make site diversity methodology attractive for rain fade compensation. Separation distances between terminals must be small to be of interest commercially. This study measures diversity gain at a separation distance <5 km and investigates utilization of S-band weather radar reflectivity in predicting diversity gain. Two USAT ground stations, separated by 2.43 km for spatial diversity, received a continuous Ka-band tone sent from NASA Glenn Research Center via the Advanced Communications Technology Satellite (ACTS) steerable antenna beam. Received signal power and rainfall were measured, and Weather Surveillance Radar—1998 Doppler (WSR-88D) data were obtained as a measure of precipitation along the USAT-to-ACTS slant path. Signal attenuation was compared for the two sites, and diversity gain was calculated for fades measured on eleven days. Correlation of WSR-88D S-band reflectivity with measured Ka-band attenuation consisted of locating radar volume elements along each slant path, converting reflectivity to Ka-band attenuation with rain rate calculation as an intermediate step. Specific attenuation for each associated path segment was summed, resulting in total attenuation along the slant path. Derived Ka-band attenuation did not correlate closely with empirical data ($r = 0.239$), but a measured signal fade could be matched with an increase in radar reflectivity in all fade events. Applying a low pass filter to radar reflectivity prior to deriving Ka-band attenuation improved the correlation between measured and derived signal attenuation ($r = 0.733$). Results indicate that site diversity at small separation distances is a viable means of rain fade compensation, and that existing models underestimate diversity gain for a subtropical climate such as Florida. Also, filtered WSR-88D reflectivity can be used for optimizing diversity terminal placement by comparing derived Ka-band attenuation between the diversity sites.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Acceptance Testing of a Satellite SCADA Photovoltaic-Diesel Hybrid System

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ABSTRACT

Savannah State University (SSU) and the Florida Solar Energy Center (FSEC) have been participating in the NASA Advanced Communications Technology Satellite (ACTS) program for the last five years. This program was designed by NASA to help maintain U.S. leadership in commercial space communications by funding high-risk research, and to flight-test next-generation digital satellite components. Launched in 1993, ACTS is an U.S. government funded technology test-bed that incorporates high power Ka-band transponders, small spot beams, and on-board digital storage and switching technology. Associated with the spacecraft, is a prototype satellite control center that supports various application experiments. The SSU/ FSEC application experiment is to developing a Photovoltaic-Diesel Hybrid Power system complete with satellite Supervisory Control and Data Acquisition (SCADA). The hybrid system was design to demonstrate the feasibility of using SCADA to maintain and operate remote village power systems. This configuration would enable experts at a central location to provide technical assistance to local technicians while they acquire a measure of proficiency with the hybrid system operation and maintenance. Upon full mastery of the technology, similar SCADA arrangement are planned to remotely monitor and control constellation of hybrid systems scattered overlarge rural areas. Two Orion Energy APEX-1000 hybrid systems were delivered in 1998, one was installed at SSU in eastern Georgia and the other was installed at FSEC in Central Florida. The project was designed to: (1) evaluate the performance of ACTS in a SCADA arrangement, (2) monitor the health and performance of all major hybrid subsystems, (3) investigate load control and battery charging strategies to maximize battery capacity and lifetime, and (4) develop satellite communication protocol. Preliminary results indicate that the hybrid design is suitable for satellite Supervisory Control and Data Acquisition. A modification to the controller software has produced a robust communication link capable of real time control and long term data collection.

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PV-Diesel Hybrid SCADA Experiment Network Design

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ABSTRACT

The essential features of an experimental network for renewable power system satellite based supervisory, control and data acquisition (SCADA) are communication links, controllers, diagnostic equipment and a hybrid power system. Required components for implementing the network consist of two satellite ground stations, to satellite modems, two 486 PCs, two telephone receivers, two telephone modems, two analog telephone lines, one digital telephone line, a hybrid-power system equipped with controller and a satellite spacecraft. In the technology verification experiment (TVE) conducted by Savannah State University and Florida Solar Energy Center, the renewable energy hybrid system is the Apex-1000 Mini-Hybrid which is equipped with NGC3188 for user interface and remote control and the NGC2010 for monitoring and basic control tasks. This power system is connected to a satellite modem via a smart interface, RS232. Commands are sent to the power system control unit through a control PC designed as PC1. PC1 is thus connected to a satellite model through RS232. A second PC, designated PC2, the diagnostic PC is connected to both satellite modems via separate analog telephone lines for checking modems' health. PC2 is also connected to PC1 via a telephone line. Due to the unavailability of a second ground station for the ACTS, one ground station is used to serve both the sending and receiving functions in this experiment. Signal is sent from the control PC to the Hybrid system at a frequency f_1, different from f_2, the signal from the hybrid system to the control PC. f_1 and f_2 are sufficiently separated to avoid interference.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Three-Dimensional Numerical Simulation of Convective Melting of Solid Particles in a Fluid

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ABSTRACT

The understanding of the phase-change characteristics for two-phase flows is important for the safety of space applications and the need for an increased number of applications in material processing. When a medium consists of packed or dispersed particles melt in a flowing fluid, at least three distinctive features arise: (a) Particles experience a full range of size variation due to phase change and collision; i.e., from initially large size to eventually diminishing within the melting zone; (b) there is momentum exchange between particles and fluid due to slip velocity and particle collision; (c) heat transfer from fluid to particles and is strongly influenced by flow characteristics, specific interfacial areas. The coupled heat, mass and momentum transfer mechanism during convective melting is further complicated due to the presence of the Earth gravity field. The density difference between fluid and particles causes the melting particles either to float to the fluid surface or settle down to the bottom of the fluid field. The resulted individual particle motion is then interacting with that from adjacent particles through collision. This makes prediction of melting rate under nonthermal equilibrium conditions very complex. Possible experiments under microgravity may give a way to study such complex phenomena by eliminating gravity related effects. To be able to perform such a task, it is important to identify the main governing parameters for complete description of convective melting processes. A physical model of two-phase flow and heat-mass transfer with the phase changes based on the theory of interacting continua is proposed. This model is proposed to simplify some aspects of the phenomena as mentioned above for a general three-dimensional application. All terms in the conservation equations are analyzed, and the constitutive equations are presented. A closed set of governing equations describing the convective melting of solid particles in a fluid is obtained. The generalized numerical method is developed for the solution of this kind set of governing equations for a three-dimensional melting case. In this case the medium consists of packed or dispersed particles that are melting in a flowing fluid. Preliminary calculation shows that the result is reasonable.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

The Design of Particle Melting in Flow Flight Module (PMF) for Microgravity Tests

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ABSTRACT

To prepare for a flight test under microgravity conditions onboard KC-135, an experimental flight module is designed. The investigation is to be conducted to study the melting characteristics of a packed bed under conditions of absence of buoyancy effects. The newly designed apparatus is a closed type flow system, unlike the earlier version that is an open channel apparatus and mainly for the ground tests. The test section consists of packed bed consists of ice grains of an initially uniform, flat-rectangular parallelepiped shape, and is initially saturated with still liquid. As the liquid flows though the bed, the solid grains melt. The downstream of the packed bed is bounded by a perforate plate through which liquid can flow while the ice particles are retained. From me digital video images the local packed bed thickness is measured under control flow rate and the melting rate can be determined from the image analysis. The temperature distribution along the horizontal direction and vertical direction is measured using 16 thermocouples. An infrared camera is mounted to sense the liquid-ice mixture temperature distribution on the boundary through a sapphire window. The supply water temperature and flow rate are controlled through a heat exchanger and a flow regulator, respectively. In order to meet the requirement for flight tests, a mechanical structure and impact analysis and an electrical power analysis are conducted.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Tennessee State University (TSU) Research Project for Increasing the Pool of Minority Engineers

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ABSTRACT

The NASA Glenn Research Center funded the 1997-1998 Tennessee State University (TSU) Research Project for Increasing the Pool of Minority Engineers. The NASA/GRC-Research Project is designed to develop a cadre of engineers who have academic and research expertise in technical areas of interest to NASA, in addition to having familiarity with the mission of the: NASA/Glenn Research Center. The goal of increasing minority participation in engineering is accomplished by: (1) introducing: and exposing minority youth to engineering careers and to the required high school preparation necessary to access engineering through two campus based precollege programs: Minority Introduction to Engineering (MITE), and Engineering and Technology Preview; (2) providing financial support through scholarships for minority youth majoring in engineering disciplines of interest to NASA; (3) familiarization with the engineering profession and with NASA through field trips and summer internships at NASA/GRC; and (4) practical research exposure and experiences through research internships at NASA/GRC.

1997-1998 Noteworthy Results

A total of 75 African-American high school students participated in three MITE '98 workshops; 56% were females and 44% were males. These students came from 14 states. Each two-week MITE '98 workshop introduced the participants to aeronautics, entranced their study of algebra and trigonometry, computer science, and African-American Literature, and: provided laboratory experiences in five engineering laboratories. Field trips were taken to technology centers and to: NASA/GRC. The NASA/GRC Sponsored Research Project also provided support for three 1998 Engineering and Technology Saturday Previews with a total of 85 middle and high school students in attendance. These students were introduced to the engineering profession through laboratory experiences in each department in the College. These previews were co-sponsored by the College's Business and Industry Cluster; the Johnson City, Tennessee Chapter of Delta Sigma Theta Sorority Inc.; the First Baptist Church from Memphis, Tennessee; and NSBE Birmingham, Alabama Graduate Chapter. In addition to the precollege programs, the Research Project provided scholarships for four (4) mechanical engineering scholars. The average grade-point average for the NASA/GRC Scholars is 3.472. These four (4) scholars interned at NASA/GRC during the summer of 1998. The NASA/GRC sponsored 1997-1998 TSU Research Project of Increasing the Pool of Minority Engineers was an overwhelming success as all goals and objectives were met or exceeded. This research project provided 164 African-American: students with academic and research experiences in technical areas of interest to NASA. They gained some degree of familiarity with NASA Glenn Research Center through interactions with Glenns engineers, and through field trips and internships at Glenn.

Significant Historical Results

Since the inception of the NASA/GRC-TSU Research Project in 1990, 708 high school students (47% female students) have participated in MITE Precollege programs. As of 1997, 71% of MITE seniors attend college with 67% of the MITE seniors enrolled in SMET degree programs, while 31% enrolled at TSU. NACME reports that African-American freshman enrollment has declined a catastrophic 17% form a high of 8,924 in 1992-1993. NACME also reports that since 1992-1993, the TSU. College of Engineering and Technology is the only HBCU engineering program to increase in engineering enrolled. Since 1990, 15 TSU engineering students participated in the NASA/GRC Research Scholars Program, 13 scholars have interned at Lewis, 10 have graduated, 4 are presently in the scholars program and one scholar is now pursuing a Ph.D. in Mechanical Engineering at Rensselaer Polytechnic Institute. MITE results are sign)ficant given the alarming decline in African-American freshman engineering enrollment. The NASA/GRC-TSU Research Project for Increasing the Pool of Minority Engineers produces desired results!

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Research and Education in Probabilistic Structural Analysis and Reliability

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ABSTRACT

This paper deals with stress analysis of a cantilever beam. The analysis was performed three different ways. The first calculations of the stresses at different regions within the body were done using simple beam theory. This is an algebraic way of arriving at the stresses without having to do extensive calculations. Stress elements were calculated at the regions of highest stress. These high stress locations were estimated by the load type/placement, and experience. The second way that the stress was calculated was by modeling and analyzing the same beam using NESSUS, a probabalistic finite element code. The final way of calculating the stresses within the beam was done by using the theory of elasticity and plane stress assumptions. This resulted in two coupled partial differential equations existing over a two dimensional domain. These plane stress equations were then solved using the finite element method by way of weighted residuals. The Galerkin-Bubov approach was implemented on the weight and shape functions. The stresses obtained from all three of the analysis methods will be compared to each other and results will be discussed.

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Copper-Based OHMIC Contacts for the Si/SiGe Heterojunction Bipolar Transistor Structure

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ABSTRACT

Silicon based heterojunction bipolar transistors (HBT) with SiGe base are potentially important devices for high-speed and high-frequency microelectronics. These devices are particularly attractive as they can be fabricated using standard Si processing technology. However, in order to realize the full potential of devices fabricated in this material system, it is essential to be able to form low resistance ohmic contacts using low thermal budget process steps and have full compatibility with VLSI/ULSI processing. Therefore, a study was conducted in order to better understand the contact formation and to develop optimized low resistance contacts to layers with doping densities corresponding to the p-type SiGe base and n-type Si emitter regions of the HBTs. These as-grown doped layers were implanted with BF_2 up to $1 \times 10^{16}/cm^2$ and As up to $5 \times 10^{15}/cm^2$, both at 30 keV for the p-type SiGe base and n-type Si emitter layers, respectively, in order to produce a low sheet resistance surface layer. Standard transfer length method (TLM) contact pads on both p and n type layers were deposited using an e-beam evaporated trilayer structure of Ti/Cu/Ti/Al (250Å/1500Å/250Å/1000Å). The TLM pads were delineated by a photoresist lift-off procedure. These contacts in the as-deposited state were ohmic, with specific contact resistances for the highest implant doses of the order of 10^{-7} Ω-cm^2 and lower.

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Sputtering Erosion in the Ion Thruster

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ABSTRACT

An experimental study is described to measure the sputtering yield at low ion energies. Molybdenum was sputtered with 100 eV xenon ions using a new set-up. An ion gun was used to generate the ion beam. The residual gas pressure was approximately $1x10^{-9}$ Torr. The ion beam current was in the range of 0.65 μA at an operational pressure of $1x10^{-5}$ Torr. The sputtered atoms were collected on two thin, 12.5-mm wide aluminum strips positioned in mutually orthogonal directions. These strips were mounted on a collector plate which formed a semi-circle of 15 mm radius around the position where the ion beam focused on the target surface. The amount of sputtered materials deposited on these aluminum foils were determined by Rutherford backscattering spectrometry (RBS) as a function of angle of ejection. The differential sputtering yields obtained from RBS measurements were subsequently converted into absolute sputtering yield.

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Characterization of Flow Behind the Fan of a Turbofan Engine

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ABSTRACT

The research grant was awarded to perform analysis of experimental data obtained from hot-wire measurements behind the fan of turbofan engine models. The experiments of were conducted at NASA Glenn Research Center. FORTRAN codes have been developed to analyze the data for flow characterization. Results obtained from the data analysis include estimates of mean and turbulent velocities, correlation and spectral functions, and turbulence scales at various locations downstream of the fan. Codes have also been developed to obtain wave number-frequency spectra from two-point measurement data from which estimates of integral scales as a function of frequency can be obtained. The codes have been tested against some known results and they are found to be satisfactory. The results obtained from the data analysis codes will be helpful for determining the turbulence characteristics of the flow and for understanding how the fan wake flow contributes to the broad band noise produced by the engines. The results might also give insights into how the fan blades and/or stator vanes can be redesigned to reduce engine noise. Furthermore, the results obtained from data analysis of the experimental data can provide valuable input to validate the computer codes developed to predict the flow field and hence the noise produced by the engine models.

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GRC HBCUs/OMUs RESEARCH CONFERENCE

Institutional Memory Preservation at NASA Glenn Research Center

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ABSTRACT

In this era of downsizing and deficit reduction, the preservation of institutional memory is a widespread concern for U.S. companies and governmental agencies. The National Aeronautical and Space Administration faces the pending retirement of many of the agency's long-term, senior engineers. NASA has a marvelous long-term history of success, but the agency faces a recurring problem caused by the loss of these engineers' unique knowledge and perspectives on NASA's role in aeronautics and space exploration. The current work describes a knowledge elicitation effort aimed at demonstrating the feasibility of preserving the more personal, heuristic knowledge accumulated over the years (Seifert et al, 1997) by NASA engineers, as contrasted with the "textbook" knowledge of launch vehicles recorded in volumes such as Husal and Huang (1992). Work on this project was performed at NASA Glenn Research Center and elsewhere, and focused on launch vehicle systems integration. The initial effort was directed toward an historic view of the Centaur upper stage which is powered by two RL-10 engines. Various experts were consulted, employing a variety of knowledge elicitation techniques, regarding the Centaur and RL-10. Their knowledge is represented in searchable Web-based multimedia presentations. This paper discusses the various approaches to knowledge elicitation and knowledge representation employed, and assesses successes and challenges in trying to perform large-scale knowledge preservation of institutional memory. It is anticipated that strategies for knowledge elicitation and representation that have been developed in this grant will be utilized to elicit knowledge in a variety of domains including the complex heuristics that underly use of simulation software packages such as that being explored in the Expert System Architecture for Rocket Engine Numerical Simulators (Mitra, Babu, Earla and Hemminger, 1998).

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Wilberforce Power Technology in Education Program

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ABSTRACT

The Wilberforce Power Technology in Education Program is a multipart program. Three key parts of this program will be described. They are:

1. WISE—The Wilberforce Summer Intensive Experience. This annual offering is an educational program which is designed to provide both background reinforcement and a focus on study skills to give the participants a boost in their academic performance throughout their academic careers. It is offered to entering Wilberforce students. Those students who take advantage of WISE learn to improve important skills which enable them to work at higher levels in mathematics, science and engineering courses throughout their college careers, but most notably in the first year d college study.
2. Apply technology to reaming. This is being done in several ways including creating an electronic chemistry text with hypertext links to a glossary to help the students deal with the large new vocabulary required to describe and understand chemistry. It is also being done by converting lecture materials for the Biochemistry class to PowerPoint format. Technology is also being applied to learning by exploring simulation software of scientific instrumentation.
3. Wilberforce participation in collaborative research with NASA's John H. Glenn Research Center at Lewis Field. This research has focused on two areas in the past year. The first of these is the deposition of solar cell materials. A second area involves the development of polymeric materials for incorporation into thin film batteries.

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WHY COSTING IS IMPORTANT ON HBCU GRANTS

WHY IS COST IMPORTANT?

COST IS OUR ONLY FISCAL MEASURE OF ACTUAL WORK ACCOMPLISHMENT. IT CAN BE UTILIZED BY MANAGEMENT TO EVALUATE THE EFFICIENCY & EFFECTIVENESS OF BUDGET EXECUTION ON OUR PROGRAMS.

WHAT DOES FORWARD FUNDING MEAN?

FORWARD FUNDING IS EXPRESSED AS EITHER

① THE AMOUNT OF FUNDING THAT ONE'S PROGRAM OR CONTRACT WILL NOT "COST" DURING THE CURRENT FISCAL YEAR. OR

② THE PERIOD OF TIME THAT YOUR CONTRACT IS FORWARD FUNDED INTO THE NEXT FISCAL YEAR. (NOTE: RB's GUIDELINE IS THAT FORWARD FUNDING BE LIMITED TO NO MORE THAN 2 MONTHS ON ALL OAST CONTRACTS)

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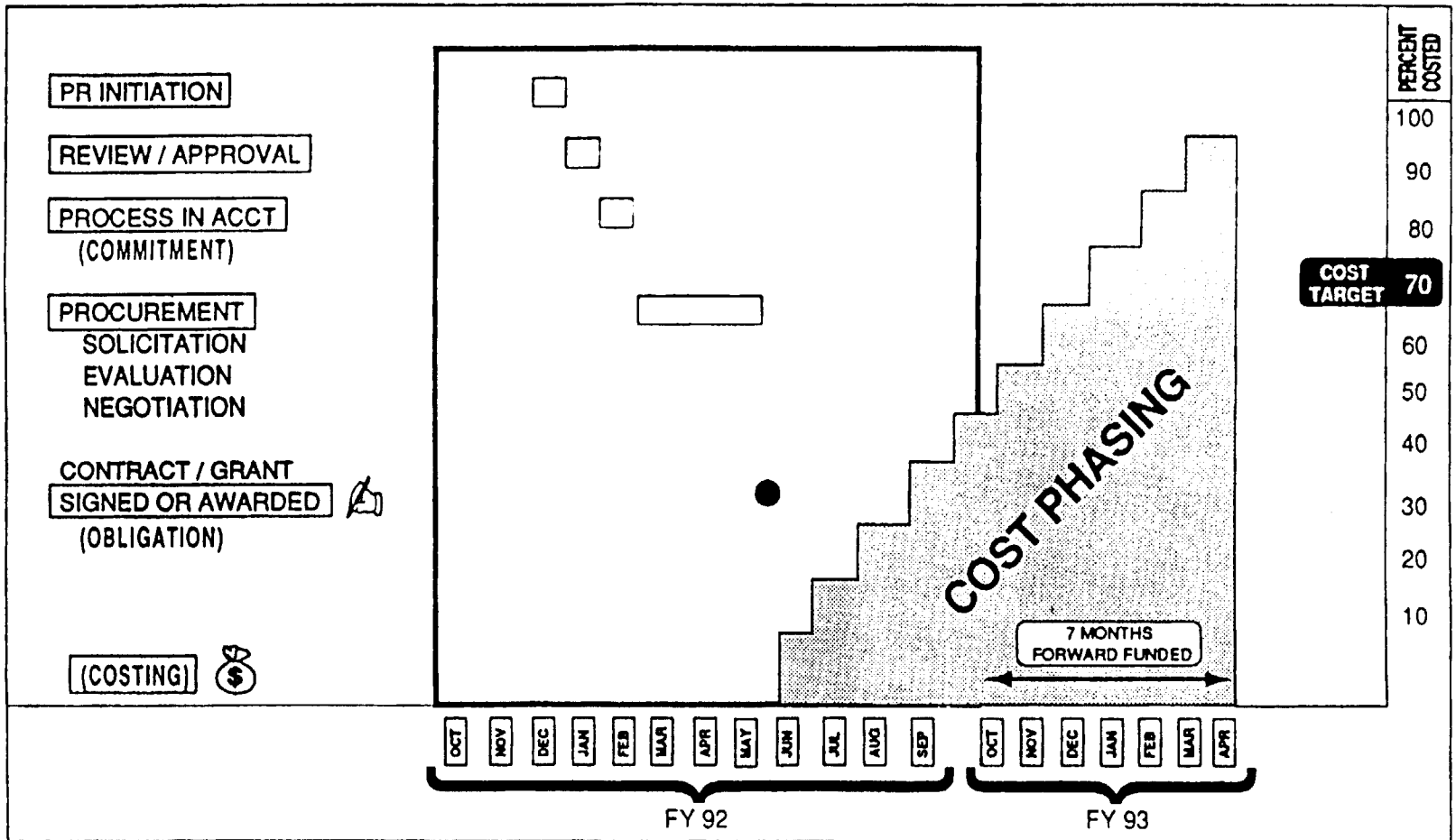
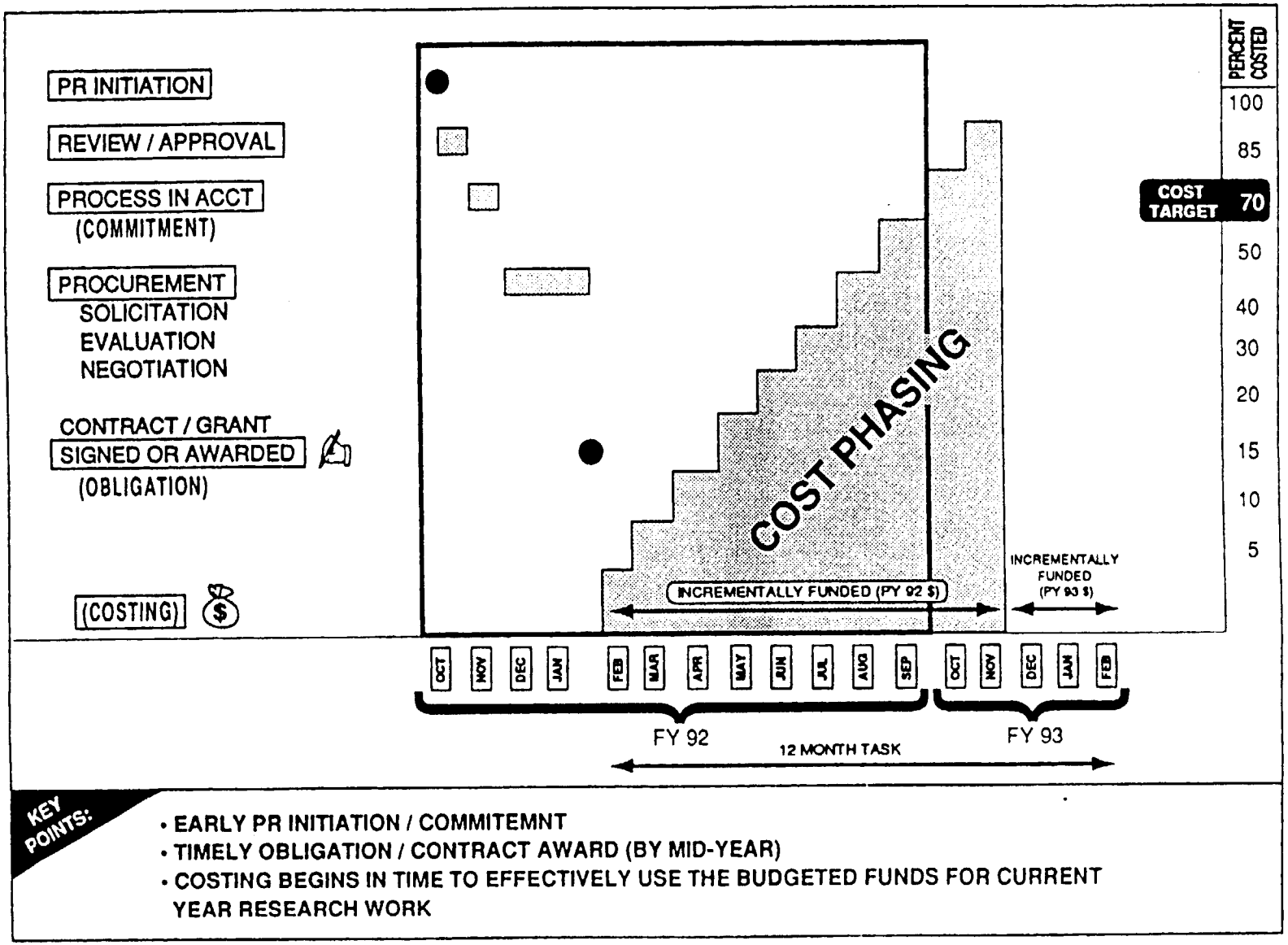
EXAMPLE OF POOR COST MANAGEMENT



KEY POINTS:

- EARLY RTOP APPROVAL AND EARLY 506 RELEASE NEED TO TRANSLATE INTO EARLY COMMITMENTS AND OBLIGATIONS
- YOU CAN'T COST FUNDS THAT ARE NOT OBLIGATED -- LATE FISCAL YEAR CONTRACT AWARDS EQUATE TO MINIMAL COST

EXAMPLE OF GOOD COST MANAGEMENT



KEY POINTS:

- EARLY PR INITIATION / COMMITEMNT
- TIMELY OBLIGATION / CONTRACT AWARD (BY MID-YEAR)
- COSTING BEGINS IN TIME TO EFFECTIVELY USE THE BUDGETED FUNDS FOR CURRENT YEAR RESEARCH WORK

COST MANAGEMENT

⚙ CHECKING ACCOUNT ANALOGY ⚙

- CODE R POLICY ALLOWS 2 MONTHS OF FORWARD FUNDING ON CONTRACTS (BEYOND 9/30) AND A CARRYOVER OF 30% OF YOUR BUDGET ALLOCATION TO COVER EXPENDITURES IN THE FOLLOWING FISCAL YEAR

- HOW MANY MONTHS OF FORWARD FUNDING DO YOU MAINTAIN IN YOUR PERSONAL CHECKING ACCOUNT?

- FLIGHT CENTERS AND MAJOR AGENCY PROGRAMS OPERATE WITH LESS THAN 2 WEEKS OF FORWARD FUNDING INTO THE FOLLOWING FISCAL YEAR

- EXTERNAL AUDIT ORGANIZATIONS CAN'T UNDERSTAND WHY WE ASK FOR FUNDS IN OUR BUDGET REQUEST THAT WE WON'T SPEND IN THE CURRENT FISCAL YEAR.

JJ/GF/1/4/93/NEW AERO AA

OFFICE OF EQUAL OPPORTUNITY PROGRAMS
MINORITY UNIVERSITY RESEARCH AND EDUCATION PROGRAMS

Cost Management

- NASA MUREP
  - At least 80% of funds should be costed by the end of Federal fiscal year (September 30)
- NASA MUREP Grantees
  - Incremental funding of large $ value grants or cooperative agreements
  - Minimize forward funding beyond 2 months into the following fiscal year
  - 100% of funds should be encumbered by the end of the grant year; funds not encumbered will be deducted from the first incremental funding, actual carryover will be deducted from the second incremental funding

How Can I Improve My Program's Cost Performance

RB Recommendations

① Timelier initiation of procurements
- "Long leadtime" acquisitions (1st Qtr)
- Planning PR's / initiations use while awaiting 506 (1st Qtr)
- Small purchases / off-the-shelf buys (2nd Qtr)
- Tasks on Support Service Contracts (1st Half of Year)

② Expanded use of "Incremental Funding" of Contracts
- Recommended 2 actions per year (1-1st Qtr; 2-Midyear)
- Avoid multiyear / 100% funding up-front scenarios
- Use incremental funding on major fixed-price contracts also

③ Limit forward funding on incrementally-funded contracts (or major tasks on Support Service Contracts) to only one month

④ Implement a one-time adjustment to start dates on major grants / contracts that are not incrementally funded (startup in 1st Qtr, NOT 4th Qtr)

⑤ Ensuring that all legitimate accrued cost on your program is recorded in your Center fiscal systems in a timely and accurate manner

⑥ Base Budget Requests upon how much $ your program will be able to cost over the 12/1/97 - 12/1/98 time frame

RECOMMENDATION

- SUBMIT ALL NECESSARY INFORMATION BILLING TO YOUR COLLEGE FINANCE, ACCOUNTING, OR BILLING OFFICES ON A TIMELY BASIS (AT LEAST ONCE PER MONTH).

- INSURE THAT YOUR COLLEGE BILLING OFFICE SUBMITS REQUIRED BILLING INFORMATION TO NASA LEWIS EACH MONTH SO THAT LEWIS MAY PROPERLY REFLECT ACCURATE UP-TO-DATE COSTING ON YOUR HBCU GRANT.

Donald J. Campbell

Donald J. Campbell is Director of the National Aeronautics and Space Administration's Glenn Research Center in Cleveland, Ohio. He was appointed to this position by NASA Administrator Daniel Goldin on January 6, 1994.

As Director, Mr. Campbell is responsible for planning, organizing, and directing the activities required to accomplish the missions assigned to the Center. Glenn is engaged in research, technology, and systems development programs in aeronautical propulsion, space propulsion, space power, and space sciences/applications. Campbell is responsible for the day-to-day management of these programs, which involve an annual budget of approximately $1 billion, just under 2800 civil service employees and 2000 support service contractors, and more than 500 specialized research facilities located near Cleveland Hopkins International Airport and at Plum Brook Station in Sandusky, Ohio.

Campbell earned a bachelor's degree in mechanical engineering from Ohio Northern University, a master's degree in mechanical engineering and did predoctoral work at Ohio State University. He completed the Senior Executive Seminar in Management at Carnegie Mellon School of Urban and Public Affairs and the Federal Executive Institute Executive Leadership program. He also completed several senior management courses at Brookings Institute.

Campbell began his government career in 1960 as a test engineer for gas turbine engines and engine components in the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio. He then worked as a project engineer and later as a program manager for advanced airbreathing propulsion systems.

From February to July 1986, Campbell was assigned as an interim Directorate Chief during the implementation of the National Aerospace Plane (NASP) Program Office, Wright-Patterson Air Force Base. He was Acting Director of the NASP Technology Maturation Directorate. In 1987, he became Acting Deputy Director of the Aero Propulsion Laboratory. In 1988, he was selected for the rank of Senior Executive Service and was appointed Deputy Program Director for the Propulsion System Program Office, Aeronautical Systems Division. He was the senior civilian executive for development and acquisition of new and derivative gas turbine engines for operational aircraft. In 1990, he was appointed Director of the Aero Propulsion and Power Laboratory. He was responsible for the Air Force propulsion and power research and development in the areas of gas turbine engines, ramjet engines, aerospace power systems, and fuels and lubricants.

In 1992, he was named Director of Science and Technology, Office of the Assistant Secretary of the Air Force for Acquisition, Washington, D.C. In this capacity he monitored the Air Force Science and Technology program and other selected research, development, technology, and engineering programs.

Campbell and his wife, Helen, have four children.

Dr. Michael J. Salkind
President, Ohio Aerospace Institute

Michael Salkind was appointed President of the Ohio Aerospace Institute in January 1990. OAI is a consortium of nine Ohio universities, private industry, NASA Glenn Research Center in Cleveland, and Wright-Patterson Air Force Base in Dayton. Its mission is to facilitate collaboration among industry, universities, and federal laboratories to enhance Ohio and U.S. economic competitiveness through research, education, and technology adaptation.

Before his appointment, Dr. Salkind served as Director of Aerospace Sciences, Air Force Office of Scientific Research, in Washington D.C. for 10 years. He was Chief of Structures at NASA Headquarters in Washington, D.C. from 1976 to 1980. From 1964 to 1975, he was with United Technologies Corporation as Chief of Advanced Metallurgy in their corporate research lab and then Chief of Structures and Materials at the Sikorsky Aircraft Division. He received his bachelor's and doctoral degrees in Materials Engineering from Rensselaer Polytechnic Institute in Troy, New York.

A fellow of the American Association for the Advancement of Science and an evaluator for the Accreditation Board for Engineering and Technology, he has published more than 40 articles and a book entitled Applications of Composite Materials.

He has also served on the adjunct faculty of The Johns Hopkins University, University of Maryland, and Trinity College in Hartford, Connecticut.

Dr. Julian M. Earls

Dr. Julian M. Earls, Deputy Director for Operations, NASA Glenn Research Center is a native of Portsmouth, Virginia. He earned the Bachelor's Degree, with distinction, in Physics from Norfolk State University; the Master's Degree in Radiation Physics from the University of Rochester School of Medicine; and the Doctorate Degree in Radiation Physics from the University of Michigan. Also, he earned the equivalent of a second Master's Degree in Environmental Health from the University of Michigan and is a graduate of the Harvard Business School's prestigious Program for Management Development. He has received the NASA Medal for Exceptional Achievement on two separate occasions.

He has 21 publications, both technical and educational. He has been Distinguished Honors Visiting Professor at numerous universities throughout the Nation and is an adjunct faculty member at Capital University, Columbus, Ohio. He was an adjunct faculty member at Cuyahoga Community College in Cleveland, Ohio. He has served on the Visiting Committee and the Board of Overseers at Case Western Reserve University, the Board of Trustees at Cuyahoga Community College, and recently was appointed by the Governor of Ohio to serve on the newly reconstructed Board of Trustees for Central State University.

Dr. Earls has received numerous honors for his community services. He has been designated the Black College Graduate of Distinction by the National Urban League and has been honored by Norfolk State University and the National Association for Equal Opportunity in Higher Education. He was inducted into the inaugural class of the National Black College Alumni Hall of Fame with such distinguished individuals as Dr. Martin Luther King, Jr. and Justice Thurgood Marshall. Recently he was honored by being among the nine individuals included in the Strong Men and Women; Excellence in Leadership Series by Virginia Power and North Carolina Power Companies. Others who have been included in the Series were: Dr. Johnnetta Cole, President of Spelman College; Henry Aaron, member Baseball Hall of Fame; Dr. John Hope Franklin, noted historian; retired General Colin Powell; Michael Jordan, Chicago Bulls basketball star; and noted poet, Maya Angelou. Dr. Earls is co-founder of the Development Fund for Black Students in Science and Technology which awards scholarships to black students who major in technical disciplines at Historically Black Colleges and Universities.

Dr. Earls is an avid runner and has run over 10,000 miles in the past five years. He has entered and successfully completed 15 marathons, including the Boston Marathon. He is married to the former Zenobia Gregory of Norfolk, Virginia, a Reading Curriculum Specialist in the Cleveland School System. They have two sons. Julian, Jr., a neurologist, is a graduate of Howard University and Case Western Reserve University School of Medicine. Gregory, a cinematographer, is a graduate of Norfolk State University and the American Film Institute in Hollywood, California.

Dr. Sunil Dutta

Dr. Sunil Dutta is Program Manager for Small Disadvantaged Businesses (SDBs) at the National Aeronautics and Space Administration's Glenn Research Center, Cleveland, Ohio. Appointed to this position in 1992, he is responsible for implementing policies that ensure the Small Disadvantaged Businesses (SDBs) and Historically Black Colleges and Universities (HBCUs) are encouraged and afforded and equitable opportunity to compete for NASA contracts and research grants. The goal is to increase R&D contracts with SDBs and research grants with HBCUs at Glenn Research Center. Before assuming the present position, his career has been devoted to research and development of materials science and technology, particularly in the area of processing, characterization, and mechanical behavior of high performance ceramics and ceramics matrix composites, for heat engines and high speed civil transport applications. In addition, he monitored numerous R&D contracts and grants for more than 10 years as project/program manager.

Dr. Dutta joined NASA Glenn Research Center in 1976 after 8 years at the U.S. Army Technology Laboratory, Watertown, Massachusetts. Born in India, he received his B.Sc (Hons), and M.S. from Calcutta University, and M.S. and Ph.D. from the University of Sheffield, England. He also received an MBA degree from Babson College, Wellesley, Massachusetts.

Dr. Dutta has written more than 50 publications including 4 patents and 5 chapters in books.

He is a Fellow of the American Ceramic Society, and the Institute of Ceramics in England. He is listed in American Men and Women in Science, Who's Who in Engineering, and Who's Who in the United States.

Dr. Dutta was invited to Japan for one year as Nippon Steel Endowed Chair Visiting Full Professor, at the University of Tokyo's Research Center for Advanced Science & Technology. Since 1987, he visited Germany, Japan, Korea, Singapore, Australia, and India to present invited technical papers/lectures. Also, actively consulted for industry and government including the CSIR (Council of Scientific and Industrial Research) laboratories in India, under the United Nations Development Program (UNDP).

He has actively participated in Local School PTA programs, as Vice-president of Canterbury Homeowners Association, as President of India Association in Boston, Massachusetts, and in Cleveland, Ohio; and co-convener of 5th biennial National Convention of All Asian-Indians in North America.

Dr. Dutta and his wife Kabita reside in Westlake, Ohio. They have three children.

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The purpose of this Historically Black Colleges and Universities (HBCUs) Research Conference was to provide an opportunity for principal investigators and their students to present research progress reports. The abstracts included in this report indicate the range and quality of research topics such as aeropropulsion, space propulsion, space power, fluid dynamics, designs, structures and materials being funded through grants from Glenn Research Center to HBCUs. The conference generated extensive networking between students, principal investigators, Glenn technical monitors, and other Glenn researchers.

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